What Is Claimed Is:

1. A low pressure, extended coverage, upright fire protection sprinkler, suitable for use in protection of at least extra hazard and high piled storage occupancies, in accordance with the 1999 Edition of NFPA 13, the sprinkler comprising:

a body defining an internal passageway extending between an inlet end and an opposite outlet end, the internal passageway having a K-factor of greater than about 16.0, where the K-factor equals an average flow of water in gallons per minute through the internal passageway divided by a square root of pressure of water fed into the inlet end of the internal passageway in pounds per square inch gauge, the outlet end having an axis;

a deflector mounted to the body by at least one support arm extending from the body and in alignment with the axis and spaced from the outlet end of the internal passageway, at a fixed position in relation to the outlet with an inner surface of the deflector opposed to flow of water in a first direction from the outlet end of the internal passageway towards a ceiling, the inner surface of the deflector configured and arranged to deflect flow of water generally radially outwardly and downwardly of the sprinkler in a second direction opposite the first direction over a protection area of at least 100 square feet; and

a thermally-responsive closure assembly mounted in a manner to secure the outlet end of the internal passageway against flow of water in a non-fire condition and to release in response to a predetermined temperature condition indicative of a fire to permit flow of water from the outlet end of the internal passageway, the thermally-responsive closure assembly including a closure element and a heat-responsive trigger mounted to releasably secure the closure element at the outlet end of the internal passageway, the heat-responsive trigger having a response time index of at least about 15 $meter^{1/2}sec^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 120 $meter^{1/2}sec^{1/2}$ ($m^{1/2}s^{1/2}$).

2. The sprinkler of claim 1, wherein the response time index is at least about 15 $meter^{1/2}sec^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 50 $meter^{1/2}sec^{1/2}$ ($m^{1/2}s^{1/2}$).

3. The sprinkler of claim 2, wherein the response time index is at least about 15 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 35 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$).

4. The sprinkler of claim 3, wherein the response time index is about 23 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$).

5. The sprinkler of claim 1, 2, 3 or 4, wherein the K-factor is between about 18 and about 41.

6. The sprinkler of claim 5, wherein the K-factor is between about 21 and about 35.

7. The sprinkler of claim 6, wherein the K-factor is between about 23 and about 27.

8. The sprinkler of claim 7, wherein the K-factor is about 25.2.

9. A low pressure, extended coverage, upright-type fire protection sprinkler, suitable for use in protection of at least extra hazard and high piled storage occupancies, in accordance with the 1999 Edition of NFPA 13, the sprinkler comprising:

a body defining an internal passageway extending between an inlet end and an opposite outlet end, the internal passageway having a K-factor of greater than about 16.0, where the K-factor equals an average flow of water in gallons per minute through the internal passageway divided by a square root of pressure of water fed into the inlet end of the internal passageway in pounds per square inch gauge, the outlet end having an axis;

a deflector mounted to the body by at least one support arm extending from the body and disposed in alignment with the axis and generally above and spaced from the outlet end of the internal passageway, at a position with an inner surface of the deflector opposed to flow of water in a first direction from the outlet end of the internal passageway towards a ceiling, the inner surface of the deflector configured and arranged to deflect flow of water generally radially outwardly and downwardly of the sprinkler in a second direction opposite the first direction over a protection area of at least 100 square feet, the deflector including a generally

planar central area generally perpendicular to the axis, the planar central area contiguous to a plurality of slanted redirecting surfaces oblique to the axis, the plurality of slanted redirecting surfaces contiguous to a plurality of tines extending at a predetermined tine angle relative to the axis; and

a thermally-responsive closure assembly mounted in a manner to secure the outlet end of the internal passageway against flow of water in a non-fire condition and to release in response to a predetermined temperature condition indicative of a fire to permit flow of water from the outlet end of the internal passageway, the thermally-responsive closure assembly including a closure element and a heat-responsive trigger mounted to releasably secure the closure element at the outlet end of the internal passageway, the heat-responsive trigger having a response time index of at least about 15 $meter^{1/2}sec^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 120 $meter^{1/2}sec^{1/2}$ ($m^{1/2}s^{1/2}$).

10. The sprinkler of claim 9, wherein the response time index is at least about 15 $meter^{1/2}sec^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 50 $meter^{1/2}sec^{1/2}$ ($m^{1/2}s^{1/2}$).

11. The sprinkler of claim 10, wherein the response time index is at least about 15 $meter^{1/2}sec^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 35 $meter^{1/2}sec^{1/2}$ ($m^{1/2}s^{1/2}$).

12. The sprinkler of claim 11, wherein the response time index is about 23 $meter^{1/2}sec^{1/2}$ ($m^{1/2}s^{1/2}$).

13. The sprinkler of claim 9, 10, 11 or 12, wherein the K-factor is between about 18 and about 41.

14. The sprinkler of claim 13, wherein the K-factor is between about 21 and about 35.

15. The sprinkler of claim 14, wherein the K-factor is between about 23 and about 35.

16. The sprinkler of claim 15, wherein the K-factor is about 25.2.

17. The sprinkler of claim 1 or 9, wherein the heat responsive trigger comprises a fusible solder element.

18. The sprinkler of claim 17, wherein the response time index is at least about 15 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 50 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$).

19. The sprinkler of claim 18, wherein the response time index is at least about 15 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 35 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$).

20. The sprinkler of claim 17, wherein the heat responsive trigger has a nominal release temperature of about 155°F or above.

21. The sprinkler of claim 1 or 9 disposed in an array of the sprinklers, wherein a first the sprinkler is spaced apart from an adjacent the sprinkler in the array at a minimum distance of about 10 feet from the axis, in a first direction generally perpendicular to a plane generally of at least one the support arm and the axis, and in a second direction generally coplanar with the plane generally of at least one the support arm and the axis.

22. The sprinkler of claim 1 or 9 disposed in an array of the sprinklers, wherein a first the sprinkler is spaced apart from an adjacent the sprinkler in the array at a distance of about 14 feet from the axis, in a first direction generally perpendicular to a plane generally of at least one the support arm and the axis, and in a second direction generally coplanar with the plane generally of at least one the support arm and the axis, whereby the first the sprinkler has a rectangular fire protection area of about 196 square feet.

23. The sprinkler of claim 1 or 9 disposed in an array of the sprinklers, wherein the pressure of water fed into the inlet end of the internal passageway is in the range of about 7 pounds per square inch to about 175 pounds per square inch.

24. The sprinkler of claim 1 or 9 disposed in an array of the sprinklers, wherein the sprinkler protects extra hazard and high piled storage occupancies, with the water supply requirements for the sprinklers being determined in accordance with the area/density calculation methods of the 1999 Edition of NFPA 13.

25. The sprinkler of claim 1 or 9 disposed in an array of the sprinklers, wherein the sprinkler protects extra hazard and high-piled storage occupancies, with the water supply requirements for the sprinklers being determined in accordance with the area/density calculation methods of the 1999 Edition of NFPA 13 for a most hydraulically remote area of sprinkler operation of about 2400 square feet or less.

26. The sprinkler of claim 25 disposed in an array of the sprinklers, wherein the water supply requirements for the sprinklers are determined in accordance with the area/density calculation methods of the 1999 Edition of NFPA 13 for an area of sprinkler operation of about 2000 square feet.

27. A low pressure, extended coverage, upright-type fire protection sprinkler comprising:

a body defining an internal passageway extending between an inlet end and an opposite outlet end, the internal passageway having a K-factor of greater than about 9.0, where the K-factor equals an average flow of water in gallons per minute through the internal passageway divided by a square root of pressure of water fed into the inlet end of the internal passageway in pounds per square inch gauge, the outlet end having an axis; and

a deflector mounted to the body by at least one support arm extending from the body and disposed in alignment with the axis and generally above and spaced from the outlet end of the internal passageway, at a position with an inner surface of the deflector opposed to flow of water from the outlet end of the internal passageway, the inner surface of the deflector configured and arranged to deflect flow of water generally radially outwardly and downwardly of the sprinkler;

the inner surface of the deflector defining

a generally planar central area intersecting and generally perpendicular to the axis, a redirecting area including a plurality of three or more slanted redirecting

surfaces extending from a radially outer peripheral edge of the central area, each at a predetermined acute angle, relative to a horizontal plane through the central area, with the radially outer perimeter of the slanted redirecting surfaces being axially relatively closer to the outlet than the central area, and

a plurality of spaced-apart tines extending from the radially outer perimeter of the slanted redirecting surfaces, towards the outlet, at predetermined tine angles, measured relative to the axis, wherein each of the plurality of three or more slanted redirecting surfaces is substantially planar, wherein the redirecting area includes four slanted redirecting surfaces, wherein each the redirecting surface is symmetrical about a vertical plane generally through its center, with an intersection of each the vertical plane with each the slanted redirecting surface defining the predetermined acute angle, measured relative to the horizontal plane through the central area, and wherein each the predetermined acute angle is between about 10 degrees and about 40 degrees so that a flow of water is provided through the outlet end of the body over a protection area of at least 100 square feet.

28. The sprinkler of claim 27, wherein each of the plurality of three or more slanted redirecting surfaces is substantially planar.

29. The sprinkler of claim 28, wherein the redirecting area comprises four slanted redirecting surfaces.

30. The sprinkler of claim 29, wherein each the slanted redirecting surface is symmetrical about a vertical plane generally through its center, with an intersection of each the vertical plane with each the slanted redirecting surface defining the predetermined acute angle, measured relative to the horizontal plane through the central area.

31. The sprinkler of claim 30, wherein each the predetermined acute angle is between about 10° and about 40°.

32. The sprinkler of claim 31, wherein each the predetermined acute angle is between about 15° and about 35°.

33. The sprinkler of claim 32, wherein each the predetermined acute angle is between about 20° and about 30°.

34. The sprinkler of claim 33, wherein the K-factor is about 25.2.

35. The sprinkler of claim 34, wherein each the predetermined acute angle is about 20°.

36. The sprinkler of claim 33, wherein the deflector comprises two or more of the spaced-apart tines extending from the radially outer perimeter of each the slanted redirecting surface towards the outlet.

37. The sprinkler of claim 36, wherein the deflector comprises three or more of the spaced-apart tines extending from the radially outer perimeter of each the slanted redirecting surface towards the outlet.

38. The sprinkler of claim 37, wherein the deflector comprises five of the spaced-apart tines extending from the radially outer perimeter of each the slanted redirecting surface towards the outlet.

39. The sprinkler of claim 38, wherein the predetermined tine angle of the two or more spaced-apart tines is between about 0° and about 25°.

40. The sprinkler of claim 39, wherein the predetermined tine angle of the two or more spaced-apart tines is between about 5° and about 20°.

41. The sprinkler of claim 38, wherein the predetermined tine angle of the three or more spaced-apart tines is between about 0° and about 25°.

42. The sprinkler of claim 41, wherein the predetermined tine angle of the three or more spaced-apart tines is between about 5° and about 20°.

43. The sprinkler of claim 38, wherein the predetermined tine angle of the five spaced-apart tines is between about 0° and about 25°.

44. The sprinkler of claim 43, wherein the predetermined tine angle of the five spaced-apart tines is between about 5° and about 20°.

45. The sprinkler of claim 38, wherein the five spaced-apart tines extending from the radially outer perimeter of each the slanted redirecting surface towards the outlet are characterized by different predetermined tine angles.

46. The sprinkler of claim 45, wherein three adjacent spaced-apart tines extending from a middle region of each the slanted redirecting surface towards the outlet are characterized by a predetermined tine angle between about 3° and about 11°, and two other spaced-apart tines extending from opposite outer regions of each the slanted redirecting surface towards the outlet are characterized by a predetermined tine angle between about 9° and about 17°.

47. The sprinkler of claim 46, wherein the three adjacent spaced-apart tines extending from the middle region of each the slanted redirecting surface towards the outlet are characterized by a predetermined tine angle of about 7°, and the two other spaced-apart tines extending from the opposite outer regions of each the slanted redirecting surface towards the outlet are characterized by a predetermined tine angle of about 13°.

48. The sprinkler of claim 33, wherein the vertical plane through center regions of a first opposing pair of the slanted redirecting surfaces is substantially perpendicular to a plane generally of at least one the support arm and the axis.

49. The sprinkler of claim 48, wherein the vertical plane through center regions of a second opposing pair of the slanted redirecting surfaces is substantially coplanar to a plane generally of at least one the support arm and the axis.

50 The sprinkler of claim 49, wherein the deflector comprises two or more of the spaced-apart tines extending from the radially outer perimeter of each of the first opposing pair of the slanted redirecting surfaces and three or more of the spaced-apart tines extending from the radially outer perimeter of each of the second opposing pair of the slanted redirecting surfaces.

51. The sprinkler of claim 50, wherein the spaced-apart tines extending from each of the first opposing pair of the slanted redirecting surfaces are characterized by a predetermined tine angle between about 10° and about 25°, and the spaced-apart tines extending from each of the second opposing pair of the slanted redirecting surfaces are characterized by a predetermined tine angle between about 10° and about 20°.

52. The sprinkler of claim 33, wherein the K-factor is about 16.8.

53. The sprinkler of claim 52, wherein each the predetermined acute angle is about 30°.

54. The sprinkler of claim 53, wherein the vertical plane through center regions of a first opposing pair of the slanted redirecting surfaces is substantially perpendicular to a plane generally of at least one the support arm and the axis.

55. The sprinkler of claim 54, wherein the vertical plane through center regions of a second opposing pair of the slanted redirecting surfaces is substantially coplanar to a plane generally of at least one the support arm and the axis.

56. The sprinkler of claim 55, wherein the deflector comprises two or more of the spaced-apart tines extending from the radially outer perimeter of each of the first opposing pair of the slanted redirecting surfaces and three more of the spaced-apart tines extending from the radially outer perimeter of each of the second opposing pair of the slanted redirecting surfaces.

57. The sprinkler of claim 56, wherein the spaced-apart tines extending from each of the first opposing pair of the slanted redirecting surfaces are characterized by a predetermined tine angle between about 10° and about 25°, and the spaced-apart tines extending from each of the second opposing pair of the slanted redirecting surfaces are characterized by a predetermined tine angle between about 10° and about 20°.

58. The sprinkler of claim 33, wherein the deflector comprises three adjacent spaced apart tines extending from a middle region of each the slanted redirecting surface towards the outlet and characterized by a predetermined tine angle of about 7°, and the deflector comprises two other spaced-apart tines extending from opposite outer regions of each the slanted redirecting surface towards the outlet and characterized by a predetermined tine angle of about 13°.

59. A low pressure, extended coverage, upright-type fire protection sprinkler, suitable for use in protection of at least extra hazard and high piled storage occupancies, in accordance with the 1999 Edition of NFPA 13, the sprinkler comprising:

a body defining an internal passageway extending between an inlet end and an opposite outlet end, the internal passageway having a K-factor of greater than about 16.0, where the K-factor equals an average flow of water in gallons per minute through the internal passageway divided by a square root of pressure of water fed into the inlet end of the internal passageway in pounds per square inch gauge, the outlet end having a vertical axis; and

a deflector mounted to the body by at least one support arm extending from the body and disposed in alignment with the vertical axis and generally above and spaced from the outlet end of the internal passageway, at a position with an inner surface of the deflector opposed to flow of water from the outlet end of the internal passageway, the inner surface of the deflector configured

and arranged to deflect flow of water generally radially outwardly of the vertical axis and downwardly of the sprinkler in a predetermined spray pattern of generally polygonal shape over a protection area of at least 100 square feet about the vertical axis when viewed at a distance of about 3 feet below the deflector and at a pressure of about 12 psig at the inlet end of the internal passageway.

60. The sprinkler of claim 59, wherein the polygonal shape spray pattern approximates a rectangular shape with the centerline through one set of opposing sides of the rectangular shape being substantially perpendicular to a plane generally of at least one the support arm and the axis.

61. The sprinkler of claim 60, wherein the rectangular shape of the polygonal shape spray pattern has minimum dimensions of about 6 feet on a side.

62. A low pressure, extended coverage, upright-type fire protection sprinkler, suitable for use in protection of at lest extra hazard and high piled storage occupancies, in accordance with the 1999 Edition of NFPA 13, the sprinkler comprising:

a body defining an internal passageway extending between an inlet end and an opposite outlet end, the internal passageway having a K-factor of greater than about 16.0, where the K-factor equals an average flow of water in gallons per minute through the internal passageway divided by a square root of pressure of water fed into the inlet end of the internal passageway in pounds per square inch gauge, the outlet end having an axis; and

a deflector mounted to the body by at least one support arm extending from the body and disposed in alignment with the axis and generally above and spaced from the outlet end of the internal passageway, at a position with an inner surface of the deflector opposed to flow of water from the outlet end of the internal passageway, the inner surface of the deflector configured and arranged to deflect flow of water generally radially outwardly and downwardly of the sprinkler in a predetermined spray pattern such that water collects at a minimum rate of about 0.15 gallon per minute per square foot in a one foot by one foot area centered at about a 9 foot radius from the axis at a distance of about 45° to a plane generally of at least one the support arm and the axis at a

distance of about 4 feet below the deflector and at a pressure of about 16 psig at the inlet end of the internal passageway.

63. The sprinkler of claim 62, wherein the minimum rate of the water collected in the one foot by one foot area centered at the 9 foot radius from the axis in any direction at about 45° to a plane generally of at least one the support arm and the axis at the distance of about 4 feet below the deflector and at the pressure of about 16 psig at the inlet end of the internal passageway is about 0.20 gallon per minute per square foot.

64. A low pressure, extended coverage, upright-type fire protection sprinkler, suitable for use in protection of at least extra hazard and high piled storage occupancies, in accordance with the 1999 Edition of NFPA 13, the sprinkler comprising:

a body defining an internal passageway extending between an inlet end and an opposite outlet end, the internal passageway having a K-factor of greater than about 16.0, where the K-factor equals an average flow of water in gallons per minute through the internal passageway divided by a square root of pressure of water fed into the inlet end of the internal passageway in pounds per square inch gauge, the outlet end having an axis; and

a deflector mounted to the body by at least one support arm extending from the body and disposed in alignment with the axis and generally above and spaced from the outlet end of the internal passageway, at a position with an inner surface of the deflector opposed to flow of water from the outlet end of the internal passageway, the inner surface of the deflector configured and arranged to deflect flow of water generally radially outwardly and downwardly of the sprinkler in a predetermined spray pattern to provide a protection area of at least 100 square feet such that more water is collected in a one foot by one foot area centered at about an 8 foot radius from the axis in any direction at about 45° to a plane generally of at least one the support arm and the axis, than in either the direction of the plane generally of at least one the, support arm and the axis, or in a direction perpendicular to the plane generally of at least one the support arm and the axis, at a distance of about 3 feet below the deflector and at a pressure of about 16 psig at the inlet end of the internal passageway.

65. A low pressure, extended coverage, upright-type fire protection sprinkler, suitable for use in protection of at least extra hazard and high piled storage occupancies, in accordance with the 1999 Edition of NFPA 13, the sprinkler comprising:

a body defining an internal passageway extending between an inlet end and an opposite outlet end, the internal passageway having a K-factor of greater than about 16.0, where the K-factor equals an average flow of water in gallons per minute through the internal passageway divided by a square root of pressure of water fed into the inlet end of the internal passageway in pounds per square inch gauge, the outlet end having an axis; and

a deflector mounted to the body by at least one support arm extending from the body and disposed in alignment with the axis and generally above and spaced from the outlet end of the internal passageway, at a position with an inner surface of the deflector opposed to flow of water from the outlet end of the internal passageway, the inner surface of the deflector configured and arranged to deflect flow of water generally radially outwardly and downwardly of the sprinkler in a predetermined spray pattern such that water collects at a minimum average rate of about 0.05 gallon per minute per square foot at a distance of about 10 feet below the deflector and at a pressure of about 16 psig at the inlet end of the passageway, in a 20 foot long array of one foot by one foot pans disposed parallel to a plane generally of at least one the support arm and the axis, the longitudinal centerline of the 20 foot long array of pans being horizontally offset 10 feet from either side of the plane generally of at least one the support arm and the axis, and the lateral centerline of the 20 foot long array of pans being located along an orthogonal plane perpendicular to the plane generally of at least one the support arm and the axis, and intersecting the axis.

66. A low pressure, extended coverage, upright-type fire protection sprinkler, suitable for use in protection of at least extra hazard and high piled storage occupancies, in accordance with the 1999 Edition of NFPA 13, the sprinkler comprising:

a body defining an internal passageway extending between an inlet end and an opposite outlet end, the internal passageway having a K-factor of greater than about 16.0, where the K-factor equals an average flow of water in gallons per minute through the internal passageway divided by a square root of pressure of water fed into the inlet end of the internal passageway in pounds per square inch gauge, the outlet end having an axis; and

a deflector mounted to the body by at least one support arm extending from the body and disposed in alignment with the axis and generally above and spaced from the outlet end of the internal passageway, at a position with an inner surface of the deflector opposed to flow of water from the outlet end of the internal passageway, the inner surface of the deflector configured and arranged to deflect flow of water generally radially outwardly and downwardly of the sprinkler in a predetermined spray pattern such that water collects at a minimum average rate of about 0.07 gallon per minute per square foot at a distance of about 10 feet below the deflector and at a pressure of about 16 psig at the inlet end of the passageway, in a 20 foot long array of one foot by one foot pans disposed parallel to a plane generally of at least one the support arm and the axis, the longitudinal centerline of the 20 foot long array of pans being horizontally offset 10 feet from either side of the plane generally of at least one the support arm and the axis, and the lateral centerline of the 20 foot long array of pans being located along an orthogonal plane perpendicular to the plane generally of at least one the support arm and the axis, and intersecting the axis.

67. A low pressure, extended coverage, upright-type fire protection sprinkler, suitable for use in protection of at least extra hazard and high piled storage occupancies, in accordance with the 1999 Edition of NFPA 13, the sprinkler comprising:

a body defining an internal passageway extending between an inlet end and an opposite outlet end, the internal passageway having a K-factor of greater than about 16.0, where the K-factor equals an average flow of water in gallons per minute through the internal passageway divided by a square root of pressure of water fed into the inlet end of the internal passageway in pounds per square inch gauge, the outlet end having an axis; and

a deflector mounted to the body by at least one support arm extending from the body and disposed in alignment with the axis and generally above and spaced from the outlet end of the internal passageway, at a position with an inner surface of the deflector opposed to flow of water from the outlet end of the internal passageway, the inner surface of the deflector configured and arranged to deflect flow of water generally radially outwardly and downwardly of the sprinkler in a predetermined spray pattern such that water collects at a minimum average rate of about 0.09 gallon per minute per square foot at a distance of about 10 feet below the deflector and at a pressure of about 16 psig at the inlet end of the passageway, in a 20 foot long array of one foot by

one foot pans disposed parallel to a plane generally of at least one the support arm and the axis, the longitudinal centerline of the 20 foot long array of pans being horizontally offset 10 feet from either side of the plane generally of at least one the support arm and the axis, and the lateral centerline of the 20 foot long array of pans being located along an orthogonal plane perpendicular to the plane generally of at least one the support arm and the axis, and intersecting the axis.

68. A low pressure, extended coverage, upright-type fire protection sprinkler, suitable for use in protection of at least extra hazard and high piled storage occupancies, in accordance with the 1999 Edition of NFPA 13, the sprinkler comprising:

a body defining an internal passageway extending between an inlet end and an opposite outlet end, the internal passageway having a K-factor of greater than about 16.0, where the K-factor equals an average flow of water in gallons per minute through the internal passageway divided by a square root of pressure of water fed into the inlet end of the internal passageway in pounds per square inch gauge, the outlet end having an axis;

a deflector mounted to the body by at least one support arm extending from the body and in alignment with the axis and spaced from the outlet end of the internal passageway, at a position with an inner surface of the deflector opposed to flow of water from the outlet end of the internal passageway, the inner surface of the deflector configured and arranged to deflect flow of water generally radially outwardly and downwardly of the sprinkler, the inner surface of the deflector defining a generally planar central area intersecting and generally perpendicular to the axis, a redirecting area including four slanted redirecting surfaces extending from a radially outer peripheral edge of the central area, each at a predetermined acute angle, relative to a horizontal plane through the central area, with a radially outer perimeter of the slanted redirecting surfaces being axially relatively closer to the outlet than the central area, and a plurality of spaced-apart tines extending from the radially outer perimeter of the slanted redirecting surfaces, towards the outlet, at predetermined tine angles, measured relative to the axis, with the intersections of adjacent the slanted redirecting surfaces of the inner surface of the deflector defining channels, the channels extending radially outwardly and downwardly of the central area to enlarged, scalloped openings defined by adjacent of the spaced-part tines at corner regions of the radially outer perimeter of the slanted redirecting surfaces with centers of the channels

disposed at about 45° to a plane generally of at least one the support arm and the axis, thereby to direct a relatively lengthened flow of water toward the corner regions of the predetermined spray pattern disposed at about 45° to the plane generally of at least one the support arm and the axis over a protection area of at least 100 square feet; and

a thermally-responsive closure assembly mounted in a manner to secure the outlet end of the internal passageway against flow of water in a non-fire condition and to release in response to a predetermined temperature condition indicative of a fire to permit flow of water from the outlet end of the internal passageway, the thermally-responsive closure assembly including a closure element and a heat-responsive trigger mounted to releasably secure the closure element at the outlet end of the internal passageway, the heat-responsive trigger having a response time index of at least about 15 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 120 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$).

69. The sprinkler of claim 68, wherein the response time index is at least about 15 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 50 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$).

70. The sprinkler of claim 69, wherein the response time index is at least about 15 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 35 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$).

71. The sprinkler of claim 70, wherein the response time index is about 23 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$).

72. The sprinkler of claim 68, 69, 70 or 71, wherein the K-factor is between about 18 and about 41.

73. The sprinkler of claim 72, wherein the K-factor is between about 21 and about 35.

74. The sprinkler of claim 73, wherein the K-factor is between about 23 and about 27.

75. The sprinkler of claim 74, wherein the K-factor is about 25.2.

76. The sprinkler of claim 68, wherein the heat responsive trigger comprises a fusible solder element.

77. The sprinkler of claim 76, wherein the response time index is at least about 15 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 50 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$).

78. The sprinkler of claim 77, wherein the response time index is at least about 15 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 35 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$).

79. The sprinkler of claim 78, wherein the heat responsive trigger has a nominal release temperature of about 155°F or above.

80. The sprinkler of claim 68 disposed in an array of the sprinklers, wherein a first the sprinkler has a permitted minimum spacing apart from an adjacent the sprinkler in the array of about 14 feet from the axis, in a first direction generally perpendicular to a plane generally of at least one the support arm and the axis, and in a second direction generally coplanar with the plane generally of at least one the support arm and the axis, whereby the first the sprinkler has a rectangular fire protection area of about 196 square feet.

81. The sprinkler of claim 68 disposed in an array of the sprinklers, wherein the pressure of water fed into the inlet end of the internal passageway is in the range of about 7 pounds per square inch to about 175 pounds per square inch.

82. The sprinkler of claim 68 disposed in an array of the sprinklers, wherein the sprinkler protects extra hazard and high piled storage occupancies, with the water supply requirements for the sprinklers being determined in accordance with the area/density calculation methods of the 1999 Edition of NFPA 13.

83. The sprinkler of claim 68 disposed in an array of the sprinklers, wherein the sprinkler protects extra hazard and high-piled storage occupancies, with the water supply requirements for the sprinklers being determined in accordance with the area/density calculation methods of the 1999 Edition of NFPA 13 for a most hydraulically remote area of sprinkler operation of about 2400 square feet or less.

84. The sprinkler of claim 83 being disposed in an array of the sprinklers, wherein the water supply requirements for the sprinklers are determined in accordance with the area/density calculation methods of the 1999 Edition of NFPA 13 for an area of sprinkler operation of about 2000 square feet.

85. A low pressure, extended coverage, upright fire protection sprinkler, suitable for use in protection of at least extra hazard and high piled storage occupancies, in accordance with the 1999 Edition of NFPA 13, the sprinkler comprising:

a body defining an internal passageway extending between an inlet end and an opposite outlet end, the internal passageway having a K-factor of greater than about 16.0, where the K-factor equals an average flow of water in gallons per minute through the internal passageway divided by a square root of pressure of water fed into the inlet end of the internal passageway in pounds per square inch gauge, the outlet end having an axis;

a deflector including an apex mounted to the body by at least one support arm extending from the body and in alignment with the axis and spaced from the outlet end of the internal passageway, at a position with an inner surface of the deflector opposed to a flow of water from the outlet end of the internal passageway, the inner surface of the deflector configured and arranged to deflect the flow of water generally radially outwardly and downwardly of the sprinkler over a protection area of at least 100 square feet, the deflector having a portion located at a position closer to the outlet than to the nosepiece; and

a thermally-responsive closure assembly mounted in a manner to secure the outlet end of the internal passageway against a flow of water in a non-fire condition and to release in response to a predetermined temperature condition indicative of a fire to permit the flow of water from the outlet end of the internal passageway, the thermally-responsive closure assembly including a

closure element and a heat-responsive trigger mounted to releasably secure the closure element at the outlet end of the internal passageway, the heat-responsive trigger having a response time index of at least about 15 meter$^{1/2}$sec$^{1/2}$ (m$^{1/2}$s$^{1/2}$) and less than about 120 meter$^{1/2}$sec$^{1/2}$ (m$^{1/2}$s$^{1/2}$).

86. A low pressure, extended coverage, upright fire protection sprinkler comprising:

a generally tubular body defining a passageway along a longitudinal axis, the passageway having a K factor greater than 16 where the K factor equals an average flow of water in gallons per minute through the passageway divided by a square root of the pressure of water fed to the body in pounds per square inch gauge, the tubular body having an outer surface cincturing the passageway, the passageway having an inner surface spaced from the outer surface, an inlet opening at one end of the body and an outlet opening at another end with the passageway extending between the openings, the outer surface having pipe threads formed thereon;

at least one frame arm coupled to the body proximate the outlet, the at least one frame arm being formed as an unitary member with the tubular body;

a closure member releasably positioned proximate the outlet so as to occlude the passageway;

a heat responsive trigger assembly, the heat responsive trigger assembly having a response time index of less than 65 meter$^{1/2}$second$^{1/2}$; and

a deflector coupled with the body through at least one frame arm so as to be spaced from and generally aligned with the outlet and the longitudinal axis, the deflector including a solid apex and a plate member coupled to the at least one frame arm and spaced from the outlet opening, the plate member including an inner surface of the deflector defining channels, a first generally planar portion, a conical second portion that extends in an oblique direction relative to the longitudinal axis, and slanted redirecting surfaces extending from the conical second portion at a second angle relative to the longitudinal axis, the slanted redirecting surfaces including a plurality of tines and a plurality of slots with at least one slot disposed between every two tines, the channels extending radially outwardly and downwardly of the planar portion to enlarged, scalloped openings defined by the spaced-apart tines, so that, when the heat responsive trigger is actuated and the closure is positioned to allow a flow of water to issue from the outlet of the

body towards a ceiling to be redirected to cover a fire in a storage situated beneath the ceiling over a protection area of at least 100 square feet.

87. The sprinkler of claim 86, wherein the response time index is at least about 15 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$) and less than about 50 meter$^{1/2}$sec$^{1/2}$ ($m^{1/2}s^{1/2}$).

88. The sprinkler of claim 87, wherein the response time index is at least about 15 meter$^{1/2}$sec$^{1/2}$($m^{1/2}s^{1/2}$) and less than about 35 meter$^{1/2}$sec$^{1/2}$($m^{1/2}s^{1/2}$).

89. The sprinkler of claim 88, wherein the response time index is about 23 meter$^{1/2}$sec$^{1/2}$($m^{1/2}s^{1/2}$).

90. The sprinkler of one of claim 85 or 86, wherein the K-factor is between about 18 and about 41.

91. The sprinkler of claim 90, wherein the K-factor is between about 21 and about 35.

92. The sprinkler of claim 91, wherein the K-factor is between about 23 and about 27.

93. The sprinkler of claim 92, wherein the K-factor is about 25.2.

94. The sprinkler of claim 1, wherein the flow of water comprises a density in gallons per minute per square foot in accordance with the 1999 Edition of NFPA 13 over a maximum protection area of about 196 square feet.